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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

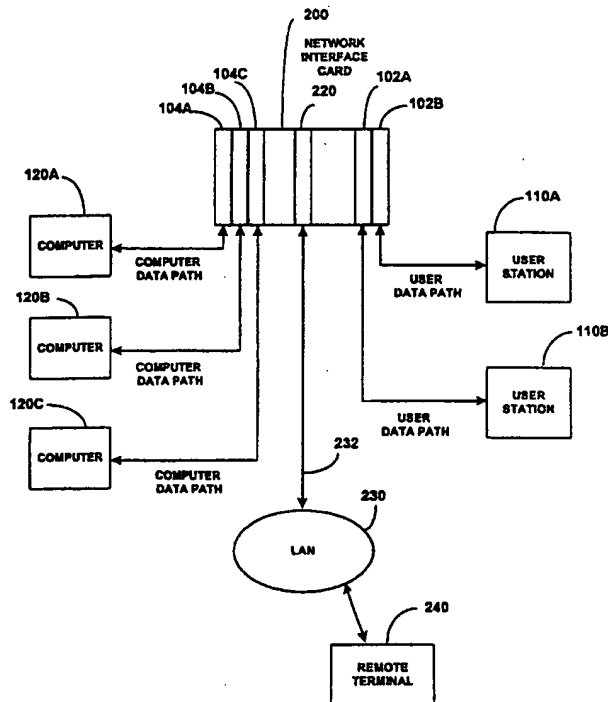
(51) International Patent Classification <sup>6</sup> : <b>G06F 13/14, 13/38</b>		A1	(11) International Publication Number: <b>WO 00/11559</b>
			(43) International Publication Date: 2 March 2000 (02.03.00)
(21) International Application Number: PCT/US99/19411		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 24 August 1999 (24.08.99)			
(30) Priority Data: 60/097,804 25 August 1998 (25.08.98) US			
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**Published***With international search report.*

(54) Title: AN APPARATUS, METHOD AND SYSTEM FOR CONTROLLING AND MONITORING A KEYBOARD, VIDEO AND MOUSE SWITCHING SYSTEM

**(57) Abstract**

An apparatus, method, and system for providing control, status, and security functions in a peripheral switch (200) for connecting one or more computers (120 A-C) to one or more user stations (110 A-B). Information from a remote terminal (240) is transferred on a network (230) in a packet where the switch information in the packet uses a standardized management protocol. When the packet is received by a network interface card (220) in the peripheral switch (200) the switch information is translated to a proprietary protocol. The peripheral switch (200) then responds to the switch information by performing a control function, providing status information to the remote terminal (240), or by changing security information. In addition to the transfer of peripheral information from the remote terminal (240), the peripheral switch (200) is capable of transferring switch information from one of the user stations (110 A-B).



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# **AN APPARATUS, METHOD AND SYSTEM FOR CONTROLLING AND MONITORING A KEYBOARD, VIDEO AND MOUSE SWITCHING SYSTEM**

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## **FIELD OF THE INVENTION**

This application relates to a switching system for selectively coupling one or more user stations to one of a plurality of computers. Each user station has at least one peripheral, where the peripherals include a keyboard, video display, and a mouse.

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## **BACKGROUND AND SUMMARY OF THE INVENTION**

A user typically communicates with a personal computer via peripherals that serve as computer-user interfaces. Such peripherals may include a keyboard, a video display and a mouse. Typically, standard cables connecting each peripheral to the computer are about four feet long and the cables are used to couple one set of peripherals to one computer.

In some computer applications it is desirable to connect one or more user stations having associated peripherals to one or more computers. It is also desirable at times to do so when the user stations and computers are at different locations. For example, users increasingly desire to retrieve information from several computers at other relatively distant locations via a peripheral switch, such as a Cybex Autoboot Commander 4XP. In such a case, the user could remain at one location and cause the peripheral switch to selectively attach up to 3,000 different computers by configuring several Commander 4XPs and using the proprietary protocol of the peripheral switch. It is also possible using peripheral switches to selectively connect several user stations to a plurality of

computers. In some of the peripheral switches, because of bandwidth limitations, not all users can operate simultaneously with computers coupled to the peripheral switch.

5 A peripheral switch typically responds to control information, provides status information, provides some type of security process, and passes data between user stations and computers. Switch information is typically classified as control information, status information, security information, and data.

The arrangement of computers, a peripheral switch, and user stations is typically referred to as a computer switching system. In many computer  
10 switching systems the peripherals at each user station comprise a keyboard, a video monitor, and a mouse. Such a grouping is sometimes referred to as a KVM station. The peripheral switch may be referred to as a KVM switch with the just described peripheral limitation.

Typically a computer switching system has a system administrator that  
15 has the ability to control the peripheral switch. The system administrator may send control information to the peripheral switch limiting activities of a selected user or user station. Further the system administrator can check the switch status by requesting status information from the peripheral switch. In addition, the system administrator may activate the security system to allow only  
20 authorized users to access the peripheral switch.

In some applications it would be desirable to interface the peripheral switch from a remote site. One option would be to provide a dedicated communication channel from the remote site to serve as a means for coupling to the peripheral switch. The dedicated communication channel could use the  
25 same proprietary language as the local peripherals and the functionality of the control, status, and security features could be controlled from the remote site. Another method of providing a remote peripheral connection could be

implemented using a remote LAN to local LAN connections. The LAN arrangement has a major shortcoming. The remote device does not know the proprietary language of the peripheral switch, hence it would be necessary for the remote device to store the proprietary language of different peripheral  
5 switches.

The present invention provides a more efficient and improved method and apparatus to couple a remote site to a peripheral switch. Such a method and apparatus would provide the control, status, and security functions in a way that mirrors the local peripheral administrative functions using industry standard  
10 LAN based protocols, such as TCP/IP and at the same time avoid the cost of a dedicated channel.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a block diagram illustrating a prior art peripheral switch coupling peripherals to computers;

15 FIG. 2 is a block diagram illustrating a peripheral switch coupled to computers in accordance with an example embodiment of the present invention;

FIG. 3 is a block diagram illustrating in more detail the peripheral switch in accordance with an example embodiment of the present invention;

20 FIG. 4 is a flow chart illustrating information flow and a packet structure in accordance with an example embodiment of the present invention;

FIG. 5 is a flow chart illustrating the information path of an example embodiment of the present invention.

FIG. 6 is a flow chart for control information from Figure 5;

FIG. 7 is a flow chart for status information from Figure 5;

FIG. 8 is a flow chart for security information from Figure 5;

FIG. 9 is a flow chart for data flow from Figure 5; and

FIG. 10 illustrates hardware aspects of the embodiment of Figure 3.

### **DETAILED DESCRIPTION OF THE DRAWINGS**

5        FIG.1 illustrates a prior art computer switching system having a prior art peripheral switch 100 with user interface cards 102A,B and computer interface cards 104A,B,C. The user stations 110A,B are coupled to the prior art peripheral switch over user data paths 112A,B. The user stations typically have peripherals such as a computer keyboard ("keyboard"), a computer video display ("video"), and a computer mouse ("mouse"). Computers 120A,B,C are  
10        coupled to the prior art peripheral switch over computer data paths 122A,B,C. The computers may be Intel based PCs, Macs, Sun Workstations, HP Computers, RS/6000 computers or similar devices. The user data paths may be serial and video cables typically used in computer and peripheral connections.  
15        The computer data paths may be typical or special cables. One such prior art peripheral switch, also known as a KVM switch is an AUTOBOOT COMMANDER 4XP made by Cybex Computer Products Corporation of Huntsville, Alabama.

20        The arrangement shown in FIG. 1 may have more than the two user stations and more than three computers. In fact several 4XPs can be used for coupling up to 3,000 computers to several user stations. When the user stations, the prior art peripheral switch, and the computers are coupled together as shown in FIG.1, the arrangement may be referred to as a KVM island. The prior art peripheral switch 100 has a communication bus and a video bus. The  
25        communication bus serves to transfer keyboard information, mouse information, status information, control information and security information and may have a

data rate of around 100 kilobits per second. Video signals, requiring higher bandwidths, are transported on one or more video busses.

In prior art systems, switch information, including control information, status information and security information, is transferred between a selected user station and a prior art peripheral switch. The protocol serving to provide the information transfer is a proprietary protocol. A prior art peripheral switch from one manufacturer typically cannot communicate with a prior art switch from another manufacturer.

Referring to FIG. 2, there is illustrated a computer switching system in accordance with the present invention. Computers 120A,B,C are coupled to user stations 110A,B over data paths and through a peripheral switch 200. Peripheral switch 200 has a network interface unit 220 as an element for coupling the peripheral switch to a network 230 which may be a local area network ("LAN") such as an ethernet. The network is coupled to the network interface card 220 using network cable 232. Although the network may be connected to numerous devices, only a remote terminal 240 is shown. The remote terminal serves as a element for remotely providing computer switch administrative functions provided by a user station in prior art computer switching systems.

In FIG. 3 there is illustrated the peripheral switch 200 having communication bus ("CBUS") 302. Computers are coupled to the communication bus via communications bus interface ("CBI") 310A, the network interface unit 220 is coupled to the CBUS via CBI 310B and user stations via CBI 310C. The CBIs serve to transmit and receive switch information and peripheral data from the CBUS using data transfer practices known to those skilled in the art. However, the protocol used in data transfers is typically a proprietary protocol. A multiplexer 312 provides several serial

ports 313 for coupling to computer serial ports (not shown). A selection element 314 and user interface circuit 316 couples and directs peripheral information and data to and from the CBUS via CBI 310C. The network interface unit 220 has a processor 320, such as an Intel 386, and a network interface circuit 330 coupled together over two way processor coupling 332. 5 The network interface circuit is coupled to the network 230 over the network coupler 232. The processor is programmed to convert switch information from the remote terminal to the proprietary protocol of the peripheral switch. Information between the network interface circuit and the network is arranged as packets as will be described in FIG. 4. 10

When a LAN packet 409, alternatively network packet, is received by the processor the steps in the flow chart of FIG. 4 illustrate the steps required to convert the packet to the proprietary protocol used by the peripheral switch. The LAN packet, is comprised of 5 sections. A preamble sequence 411 is used 15 to synchronize the receiving and transmitting stations, since the communication between the network 230 and the network interface card is bursty and asynchronous. A source address 412 and destination address 413 are required to assure the network packet arrives at the node of the network. The network payload 414 contains the data for the protocol packet 419. A network CRC 415 20 is provided to assure error free data transfers. The protocol packet contains protocol information 431 including a network logic address, sequencing information, protocol control information and protocol status information. Those skilled in the art of network to computer connections could provide variations in the protocol packet and thus the present invention is not limited in 25 scope to any particular protocol shown. A protocol CRC 433 is provided to assure that an error free protocol packet is transferred. The payload of the protocol packet 432 is an application packet 429. The application packet contains routing information 441, information for the peripheral switch 442, and



a application packet CRC 443. The routing information directs the application packet to a translator in the processor for converting a standard management protocol, such as SNMP, to the proprietary protocol of the peripheral switch. Other screen or terminal based protocols, such as TELNET, may also serve to provide access. The information 442 has security authorization data and peripheral switch information including control information, status information, security information and data. Details of the network packet parsing process is illustrated in a flow chart 400.

After being coupled to the processor 320 via network interface circuit 330 the LAN packet 409 is received by the processor, step 410. The LAN packet is processed to determine if LAN packet is error free. If the LAN packet is erred then processing stops at the YES path of step 422. Otherwise, the packet payload is parsed from the LAN packet, step 424, to obtain a protocol packet 419. The protocol packet is processed to determine if the protocol packet is error free, step 430. If the protocol packet is erred, then the processing stops at the YES path of step 432. Otherwise, processing continues on the NO path of step 432. The protocol packet is then parsed, step 434, to obtain the application packet 431. The application packet is processed for errors, step 440. If the application packet is erred, then processing stops at the YES path of step 442. Otherwise, processing continues on the NO path of step 442. The application packet arranged as a standard management protocol, such as SNMP, is then translated to the proprietary protocol of the peripheral switch, step 444. The proprietary protocol has a section 1 containing security authorization information. The security authorization information is obtained by parsing the proprietary protocol, step 450. If the security authorization information is not valid at the NO path of step 452, then processing stops. Otherwise, the proprietary protocol information begins on the NO path of step 452 and step 500.

Referring now to FIG. 5, a flow chart illustrates the processing steps for the proprietary protocol. A second section of the proprietary protocol is separated into authorization information and switch information at step 520.

5 The application packet is checked for errors and the processing ends if an error is detected at the YES path of step 530. If the application packet has no errors then the select step 540 determines the type of information received by the processor and directs the information for control information processing, step 600, status information processing, step 700, security information processing, or data information processing, step 900.

10 Control information consists of commands to a user interface card or commands routed through the user interface card to other devices within the computer switching system. Examples of commands include responding to status queries, clearing a detected Alarm, setting a threshold of a device Alarm, enabling an Alarm or disabling an Alarm. Control commands are also used to  
15 initiate downloading of program data to a system device. Control commands for action by the user interface card include commands that allow the communication bus or user data to be coupled to the remote interface via a LAN. Control commands are also used to start a processor reboot and for system maintenance function control including remote manipulation of  
20 time/date functions.

Referring now to FIG. 6, if the LAN packet from the remote terminal is authorized to initiate such a command at the YES path of step 620, then the control information is accepted and the control function initiated at step 630. If authorization is not allowed at the NO path of step 620, then processing stops.

25 Status information is stored in peripheral switch memory and is typically in table form. Status information is a view of the general system health and configuration. The view includes a list of devices contained within the system,

device Alarm status and activity status (online, offline, and connection routings). The user makes control and security decisions based on past and current status information.

Referring now to FIG. 7, if the LAN packet from the remote terminal is  
5 authorized to request status at the YES path of step 720, then status information is retrieved at step 730. The retrieved status information is then placed in a return LAN packet at step 740, and sent back to the remote terminal. If a status request is not authorized, then processing stops at the NO path of step 720.

Security information sent to the peripheral switch is used to change  
10 authorization profiles. Security information allows limited privileges to users as determined by the system administrator. Referring now to FIG. 8, if the LAN packet from the remote terminal is authorized to update security information at the YES path of step 820, then security information is updated at step 830. If a security update is not authorized, then processing stops at the NO path of step  
15 820.

Data may also be transferred between the peripheral switch and the remote terminal. Such data includes device serial data, mouse data, keyboard data, and digital video data. If the selection step 540 determines the application packet is data, then data is processed by the flow chart 900 of FIG. 9. Data  
20 processing starts at step 910, and authorization is verified. If data processing is not authorized at the NO path of step 920, then processing stops. Otherwise, processing continues on the YES path of step 920. Next it is determined if data translation is required, such as translating digital video to analog video. If translation is required at the YES path of step 930, then translation is performed  
25 at step 932. If no translation is required, the process continues on the NO path of step 930. If the data has been received at the RECEIVE path of step 934, then the data is directed to a selected connection at step 936. If the data is to be

transmitted at the TRANSMIT path of step 934, then the data is fetched at step 938, and packetized at step 940 for transmission back to the remote terminal.

Those skilled in the art of data processing would appreciate that variation in the programs described by the flow charts of FIGs 4-9 could provide steps to accomplish the overall functions of providing switch information and data to the peripheral switch using a network such as a LAN. The present invention allows a system administrator to communicate with the peripheral switch either from a remote terminal or from a user station. The option of having two communication means allows one means to serve as a backup for the other means.

In addition to the block diagrams and the flow charts above, hardware requirement are shown in FIG. 10. An Intel 386 microprocessor 1010 coupled to a boot chip 1012, to a flash drive 1014, and a RAM 1016 is used as the heart of processor 320. A video chip 1042 is used to convert digital video to analog video. The path taken by the analog video is directed by the video selector 1040 in response to a video control signal from the CBI 1028. The CBI is implemented using an Intel 8031. The interface circuit 1030 is comprised of electrical circuit elements typically used in a network to processor interface. The structure shown and elements used could have variations and still be within the scope of the present invention. Those skilled in the art would recognize the relationship and functionality of the elements shown and arranged in FIG. 10.

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

**WHAT IS CLAIMED IS:**

1           1. In a computer switching system having a peripheral  
2 switch for connecting one or more computers to one or more user  
3 stations, a method of transferring switch information including  
4 control information, status information, security information and  
5 data between the peripheral switch and a remote terminal at a  
6 remote site, the method comprising:  
7           generating, at the remote terminal, a remote information  
8 signal having switch information;  
9           packetizing the remote information signal thereby creating a  
10 network packet;  
11           transmitting the network packet to the peripheral switch via  
12 a network;  
13           receiving the network packet at the peripheral switch;  
14           translating the network packet to a proprietary information  
15 signal identifying the switch information; and  
16           responding to the proprietary information signal identifying  
17 the switch information.

1           2. The method of claim 1 where the translating step  
2 comprises:  
3           translating the network packet to a protocol packet;  
4           translating the protocol packet to an application packet; and  
5           translating the application packet to a proprietary  
6 information signal having the switch information.

1           3. The method of claim 1 wherein the remote information  
2 signal is based on a LAN protocol.

1           4. The method of claim 1 wherein the network packet has  
2 error detection information.

1           5. In a computer switching system having a peripheral  
2 switch for connecting one or more computers to one or more user  
3 stations, a network interface unit for translating a network packet  
4 from a remote terminal to a proprietary switch signal containing  
5 switch information, the network interface unit comprising:  
6           a network interface circuit for receiving the network packet  
7 and converting the network packet to a processor readable network  
8 packet; and  
9           a microprocessor programmed to parse the readable network  
10 packet by converting the network packet to a protocol packet, then  
11 converting the protocol packet to a proprietary packet protocol and  
12 upon verifying authorization responding to switch information  
13 contained in the network packet.

1           6. The network interface unit of claim 5 further comprising:  
2           a communication bus interface for coupling switch  
3 information to a communication bus in the peripheral switch.

1           7. The network interface unit of claim 6 further comprising;  
2           a video interface circuit for converting serial video to  
3 analog video and coupling the analog video to a video bus.

1           8. The network interface unit of claim 5 wherein the  
2 protocol for transferring the network packet to the network  
3 interface circuit is TCP/IP.

1           9. The network interface unit of claim 5 wherein the switch  
2 information in the network packet is generated in accordance with  
3 a standard management protocol.

1           10. In a computer switching system having a peripheral  
2 switch for connecting one or more computers to one or more user  
3 stations, a method of processing a network packet containing  
4 switch information from a remote site, the method comprising:  
5           determining if the network packet is erred, if erred exit, else;  
6           parsing the network packet to obtain a protocol packet;  
7           determining if the protocol packet is erred, if erred exit,  
8 else;  
9           parsing the protocol packet to obtain an application packet;  
10          determining if the application packet is erred, if erred exit,  
11 else; and  
12          parsing the application packet to obtain a proprietary packet.

1           11. In a computer switching system having a peripheral  
2 switch for connecting one or more computers to one or more user  
3 stations, an apparatus for transferring switch information  
4 comprising:  
5          means for transferring switch information between the  
6 peripheral switch from one of the user stations;

7 a remote terminal coupled to the peripheral switch over a  
8 network, where the network serves as a channel for transferring  
9 network packets switch information between the peripheral switch  
10 and the remote terminal; and

11 a controller having means for selecting and responding to  
12 switch information provided by one of the user stations and by the  
13 remote terminal.

1 12. A KVM switch, comprising:

2 KVM switching circuitry internally communicating via a  
3 proprietary data protocol;

4 a network interface circuit having a first data interface  
5 communicating with the KVM switching circuitry in accordance  
6 with the proprietary data protocol and a second data interface  
7 coupled to a network external to the KVM switch and  
8 communicating in accordance with a standard network protocol.

1 13. A KVM switch as in claim 12, further including a  
2 common housing having KVM ports linking the KVM switching  
3 circuitry to a plurality of computers and user stations, wherein:

4 the KVM switching circuitry and the network interface  
5 circuit are contained in the common housing.

1 14. A KVM switch as in claim 13, further including a back  
2 plane in the common housing and wherein the KVM switching  
3 circuitry and the first data interface communicate therebetween via  
4 the back plane.



1           15. A KVM switch as in claim 14, wherein;  
2           the first data interface includes a back plane interface circuit  
3 coupled between the network interface circuit and the back plane;  
4 and  
5           the KVM switching circuitry further includes another back  
6 plane interface circuit coupled between the KVM switching  
7 circuitry and the back plane.

1           16. A KVM switch as in claim 12, further including a rack  
2 and wherein:  
3           the KVM switching circuitry includes a set of computer  
4 interface cards communicating with corresponding ones of a  
5 plurality of computers, and at least one user peripherals card  
6 communicating with external computer peripherals equipment;  
7 and  
8           the network interface circuit includes a network card having  
9 the first and second data interfaces.

1           17. A KVM switch as in claim 16, further including a data  
2 bus and wherein:  
3           the computer interface cards, user peripherals card and  
4 network card all communicate with each other on the data bus in  
5 the proprietary data protocol.

1           18. A KVM switch as in claim 17, wherein the network  
2 card includes a processor to convert information in the proprietary

3 data protocol received from the user peripherals card on the data  
4 bus to the standard network protocol.

1 19. A KVM switch as in claim 17, wherein the network  
2 card includes a processor to convert information in the proprietary  
3 data protocol received from the user peripherals card and the  
4 computer interface cards on the data bus to the standard network  
5 protocol.

1 20. A KVM switch as in claim 17, wherein the network  
2 card includes a processor to convert information in the standard  
3 network protocol received from the standard network to the  
4 proprietary data protocol for delivery onto the data bus.

1 21. A KVM switch as in claim 19, wherein the network  
2 card includes a processor to convert information in the standard  
3 network protocol received from the standard network to the  
4 proprietary data protocol for delivery onto the data bus.

1 22. A KVM switch as in claim 12, wherein the network  
2 interface circuit includes a processor to convert information in the  
3 proprietary data protocol at the first data interface to the standard  
4 network protocol at the second data interface.

1 23. A KVM switch as in claim 22, wherein the network  
2 interface circuit includes a processor to convert information in the  
3 standard network protocol at the second data interface to the  
4 proprietary data protocol and the first data interface.

1           24. A KVM switch linking a set of computer peripherals to  
2 a selected one of a plurality of computers, including:  
3           a data bus employing a data protocol proprietary to the  
4 KVM switch;  
5           a computer interface circuit connected to a selector circuit  
6 and establishing a communication link between the selected one of  
7 the plurality of computers and the data bus;  
8           a computer peripherals interface circuit connected to the set  
9 of computer peripherals to establish a communication link  
10 between the set of computer peripherals and the data bus; and  
11           a network interface circuit connected to a standard network  
12 to establish a communication link between the standard network  
13 and the data bus including a converter to receive data from the  
14 standard network in a standard network protocol and modify it  
15 into the data protocol proprietary to the KVM switch for delivery  
16 to the data bus.

1           25. A KVM switch as in claim 24, wherein the data from  
2 the standard network includes control data containing information  
3 used by the selector circuit to establish the communication link  
4 between the selected one of the plurality of computers and the data  
5 bus.

1           26. A switch, comprising:  
2           a data bus;  
3           a video bus;

4           a user data input port receiving computer peripheral  
5 equipment data and putting the peripheral equipment data on the  
6 data bus;

7           a user video output port delivering video data from the  
8 video bus;

9           a computer selector coupled to a plurality of computers and  
10 establishing a communication path to a selected one of the  
11 computers to receive therefrom the video data;

12           a computer data output port receiving the peripheral  
13 equipment data from the data bus and delivering it to the computer  
14 selector for delivery to the selected one of the computers;

15           a computer video input port delivering the video data from  
16 the selected one of the computers for delivery to the video bus;  
17 and

18           a bidirectional network port for linking the video data and  
19 the peripheral equipment data on the data bus to an external  
20 network.

1           27. A switch as in claim 26, wherein the peripheral  
2 equipment data includes keyboard data.

1           28. A switch as in claim 26, wherein the peripheral  
2 equipment data includes mouse data.

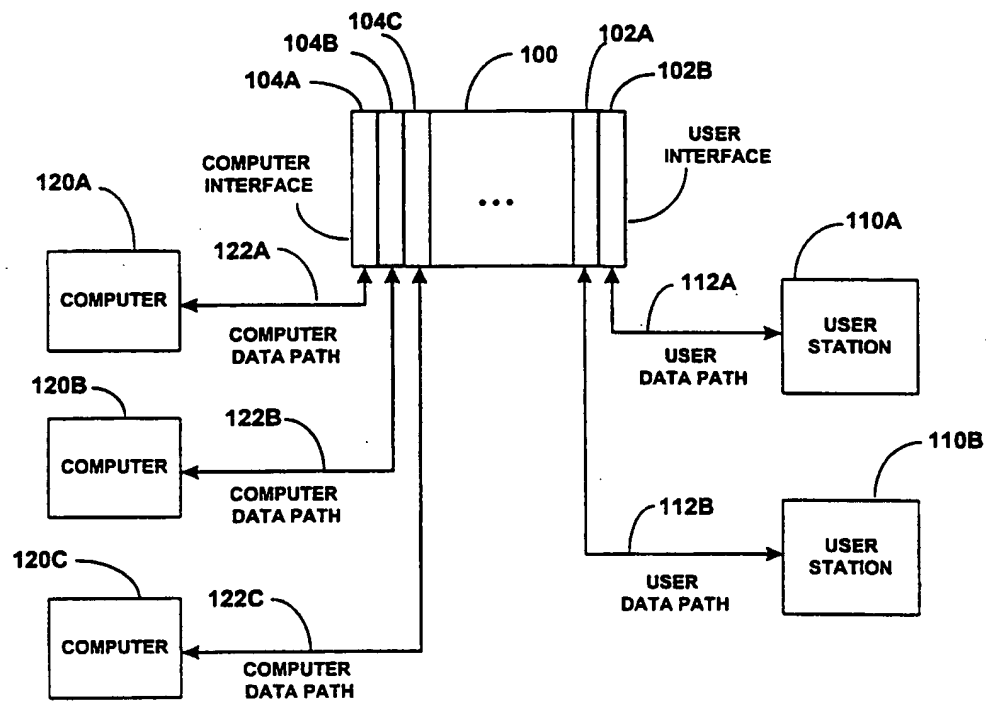
1           29. A method of transferring control data from a network to  
2 a peripheral switch, comprising:  
3           connecting a plurality of computers to the peripheral switch;

4 connecting at least one user input device to the peripheral  
5 switch;  
6 at the peripheral switch containing the control data in a  
7 standard network protocol format;  
8 receiving a network packet in a standard network protocol  
9 format;  
10 translating the network packet to a proprietary information  
11 signal identifying the control data to the peripheral switch; and  
12 setting a status of the peripheral switch based on the  
13 proprietary information signal identifying the switch information.

1 30. A method as in claim 29, wherein the step of setting  
2 includes linking a selected one or more of the plurality of  
3 computers to a selected one user input device.

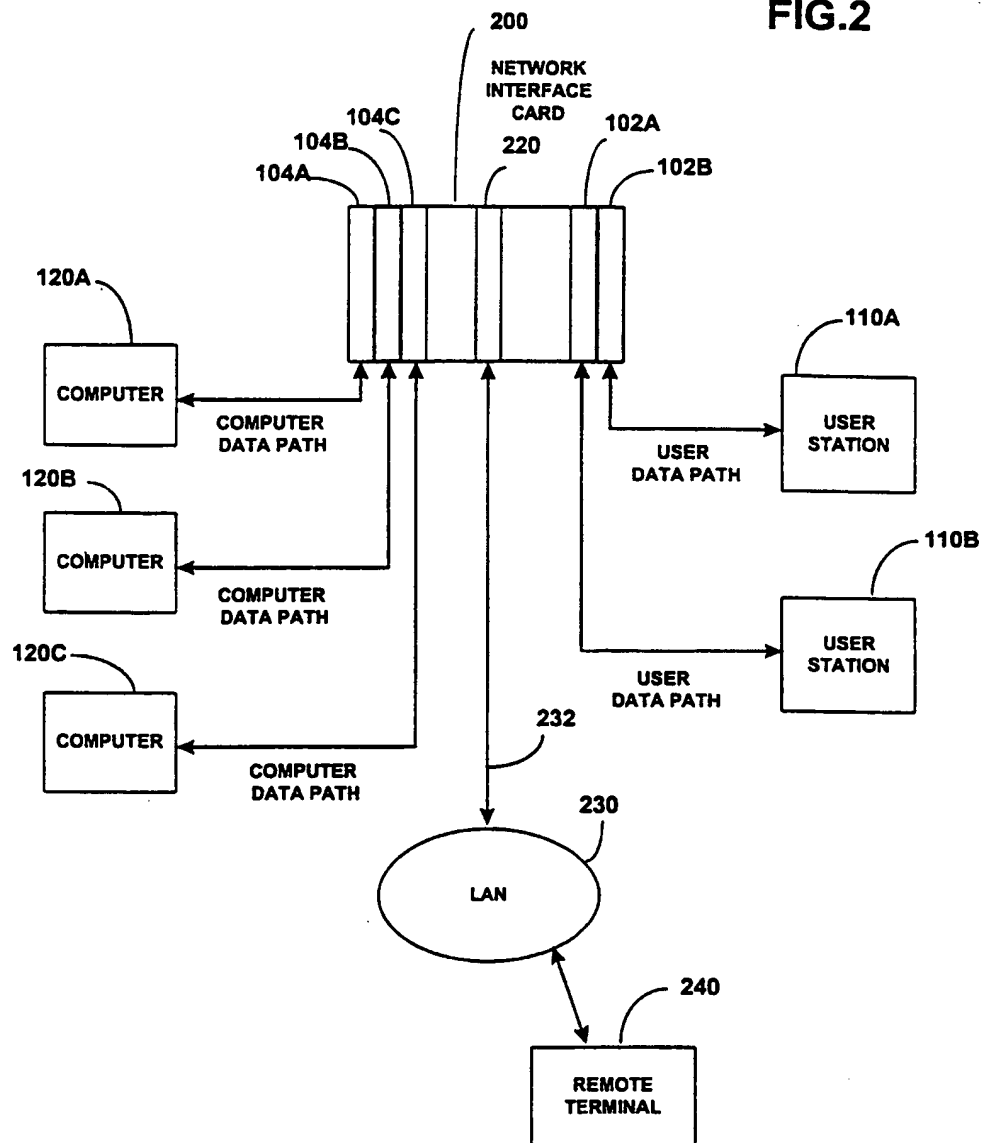
FIG.1

PRIOR ART



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FIG.2



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FIG.3

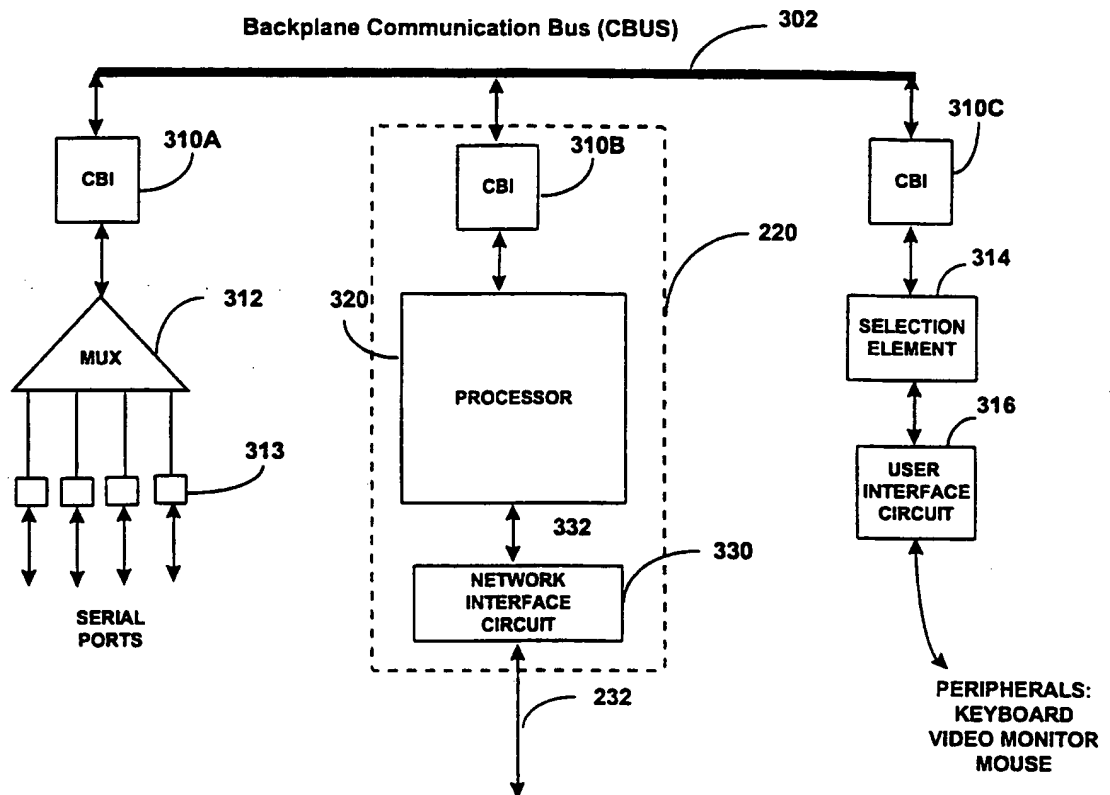
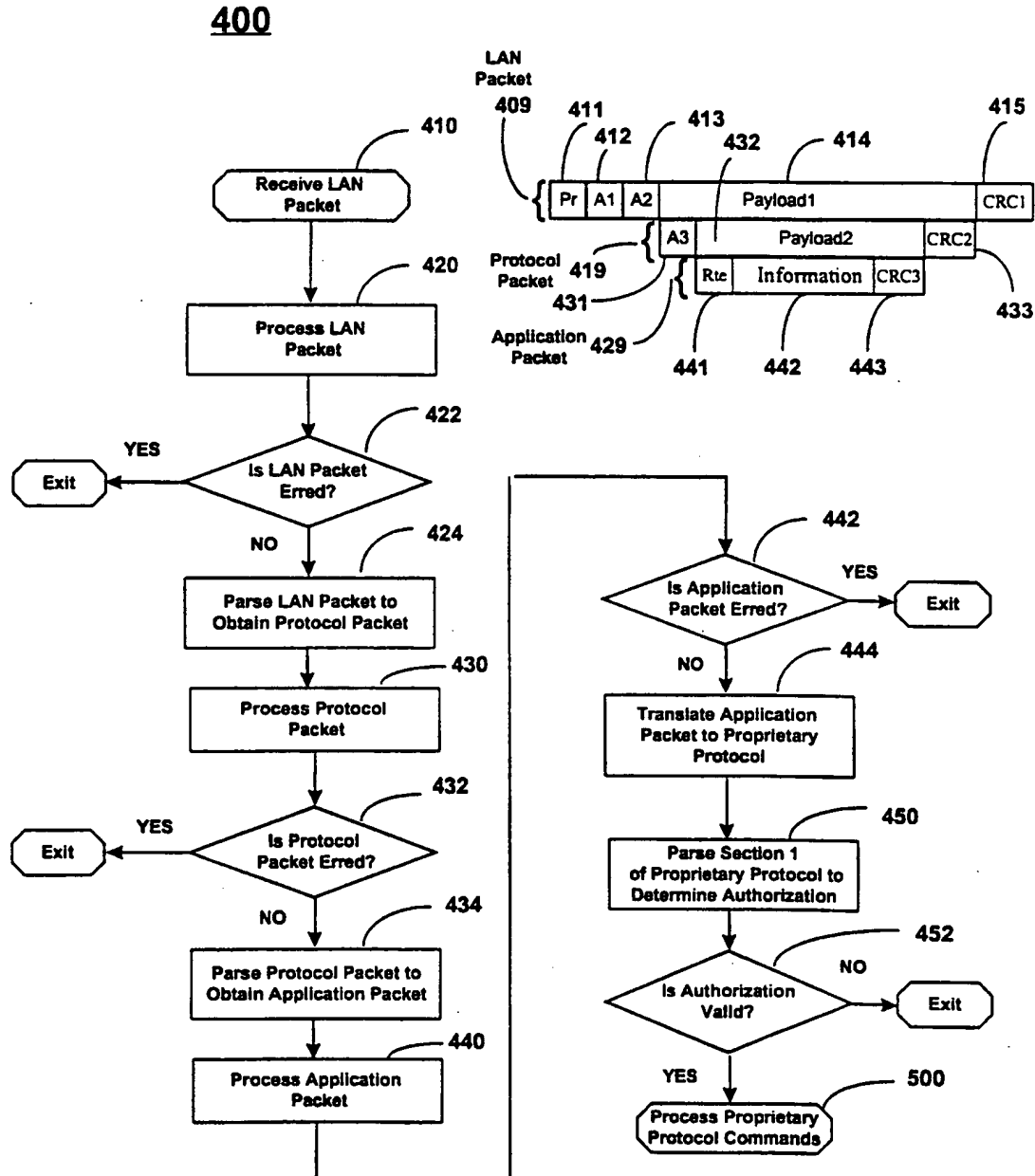


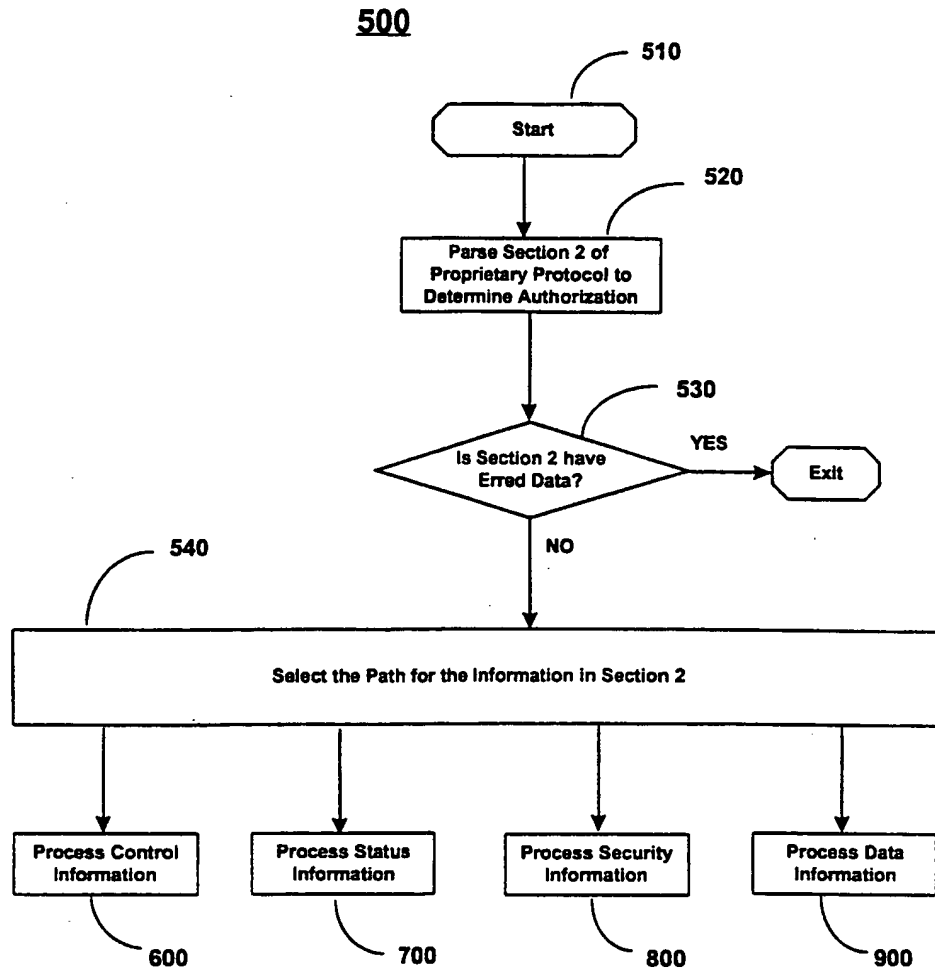


FIG.4



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FIG.5



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FIG.6

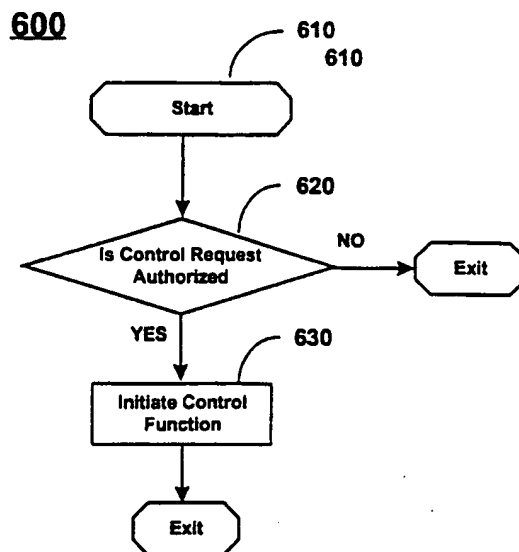
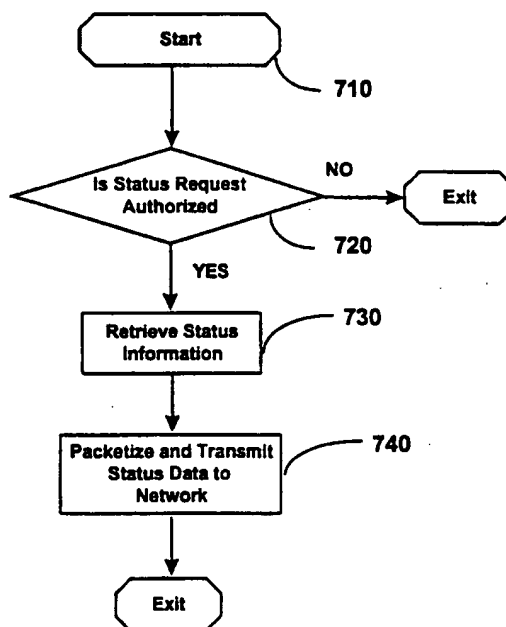
**700**

FIG.7



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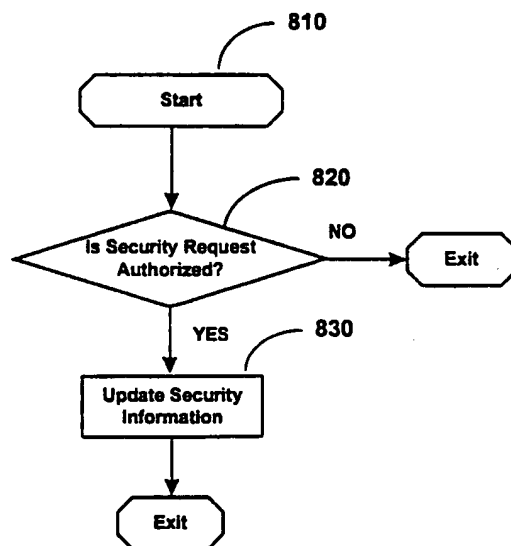
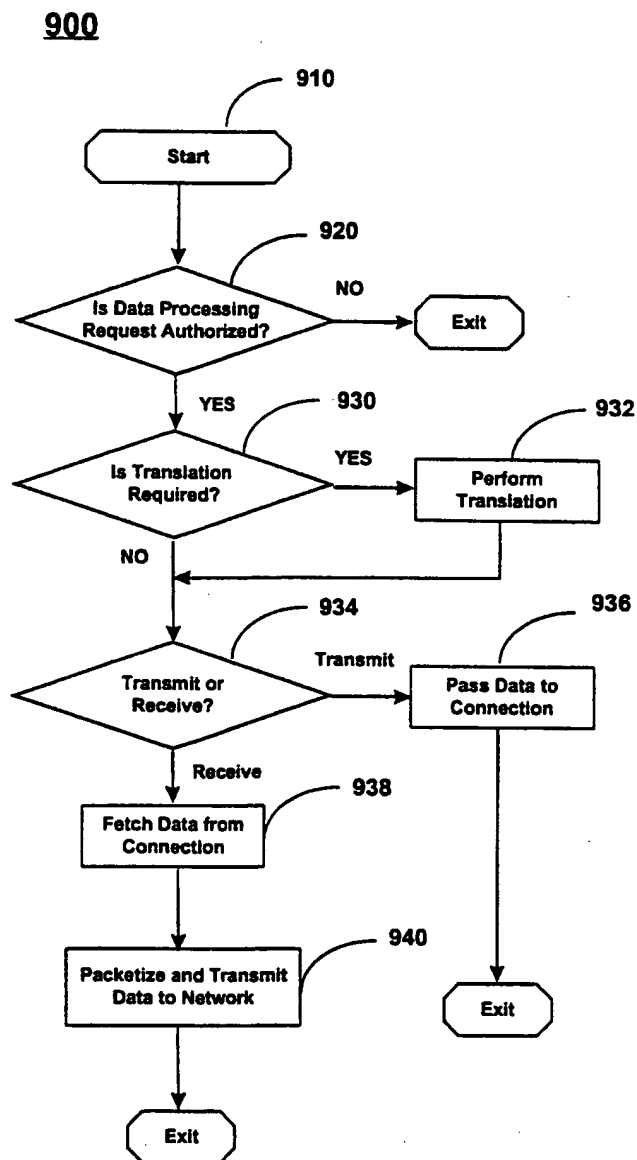
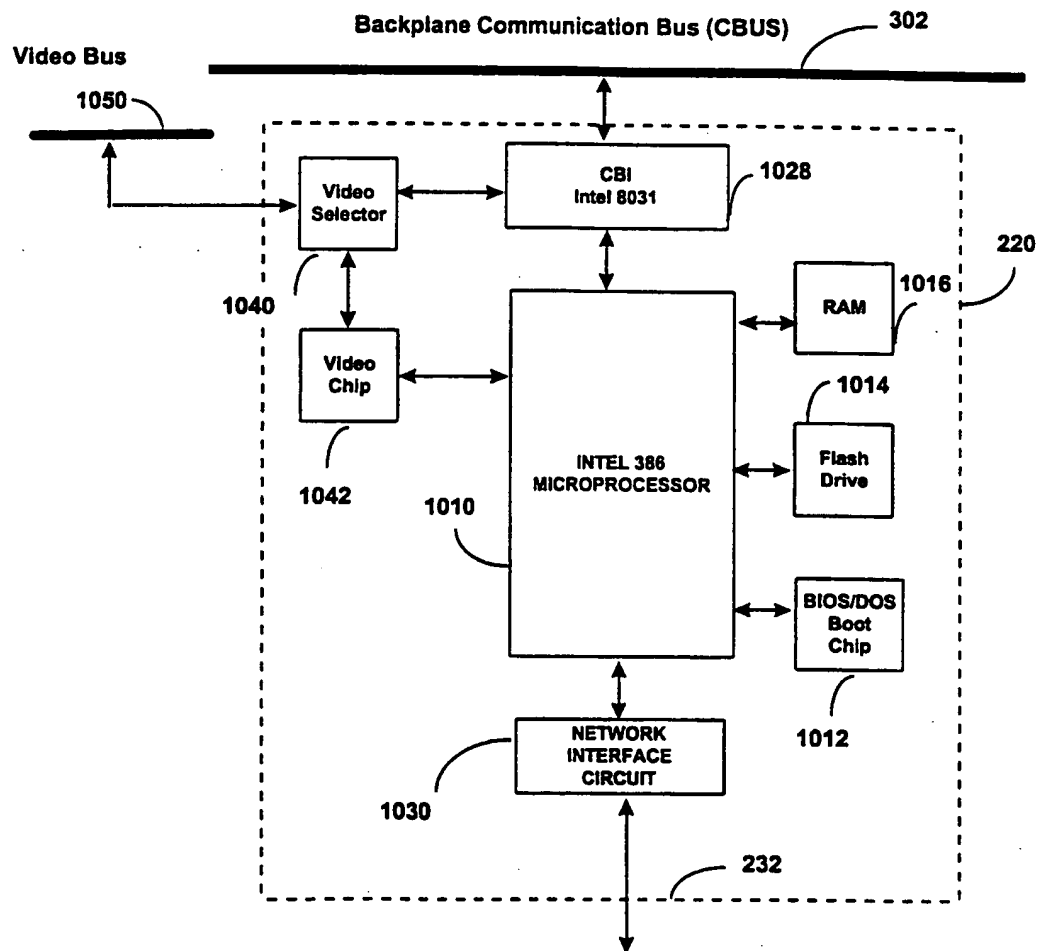
800**FIG.8**

FIG.9



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FIG. 10



## INTERNATIONAL SEARCH REPORT

 International application No.  
 PCT/US99/19411

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G06F 13/14, 13/38

US CL : 710/64, 65, 72

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 710/64, 65, 72

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

USPAT, JPO, EPO

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,721,842 A (BEASLEY ET AL.) 24 FEBRUARY 1998, see entire document, especially figure 1.	1-30
X	US 5,740,246 A (SAITO) 14 APRIL 1998, see entire document, especially figure 4.	1-30
X, P	US 5,884,096 (BEASLEY ET AL.) 16 MARCH 1999, see entire document, especially figure 2.	1-30

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents: *A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed		*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art *Z* document member of the same patent family
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Date of the actual completion of the international search

21 OCTOBER 1999

Date of mailing of the international search report

03 DEC 1999

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 Washington, D.C. 20231

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